

Simulation & PCB Designing of Digital Circuits using Toolkit for Interactive Network Analysis Software

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Abstract—Simulation of circuits is very necessary from the electronics engineering point of view. Design of experiment in electronics engineering laboratories, like in Digital Electronics, Electronics Measurement & Instrumentation, Basic of Electronics, Analog Electronics etc., requires various components to make circuits and then further experiments are performed by using these circuit. But sometime it is difficult to carry the required components or chances of physical damages are always there. To deal with these kind of difficulties this paper describe the very popular circuit simulation tool which is known as TINA (Toolkit for Interactive Network Analysis) with the help of digital circuit examples. Further the implementation of the circuit on PCB (Printed Circuit Board) is also depicted.

Index Terms— Digital, Gates, Layout, Printed Circuit Board, Schematic, TINA.

I. INTRODUCTION

To explore the knowledge of the learner or students laboratories play vital role. Theory that we read inside the classroom is actually applied in real time inside the laboratories by using various equipment. For example, if we are reading any digital circuit in the classroom then by using various digital ICs and other digital component we apply that knowledge in practice. Although laboratory experiments are very much required but still there are some problems like unavailability of any component, damage of components due to excess current, various kind of error associated with the components and instruments, requirement of huge number of components & their proper maintenance, calibration requirement and temperature effect, environmental effects etc. are always there Ref. [1-2]. Hence to find solution to these problems, best alternate is computer simulation using softwares like TINA (Toolkit for Interactive Network Analysis), OrCAD, Multisim etc. which are having the capability to replace real components & instruments with virtual ones. To meet all these requirement TINA (Toolkit for Interactive Network Analysis) is a very useful software which contains all the required virtual components library. Components and instruments like resistor, inductor, capacitor, switches, logical gates, voltmeter, millimeter, oscilloscope etc. can be directly added by using the respective components library from TINA (Toolkit for Interactive Network Analysis) Tools Library. The main aim of this paper is to describe one of the most popular circuit simulation software TINA (Toolkit for Interactive Network Analysis) with the help of examples.

II. TINA SOFTWARE INTRODUCTION

TINA is a powerful software design tool which include schematic editor, building of circuit, analysis capability, testing & measurement and PCB design Ref. [3-4]. The complete software package of TINA is also known as “The Complete Electronic Lab” and it is created by Design Soft Ref. [1].

To design any circuit 1st step is to use schematic editor window, which is shown in the Figure 1. Schematic editor as shown in the figure consist of various library that can be directly access which includes Basis, Switches, Meters, Sources, Semiconductor, Optoelectronics, Spice Macros, Gates, Flip-Flops, AD/DA-555, RF, Analog Control and Special.

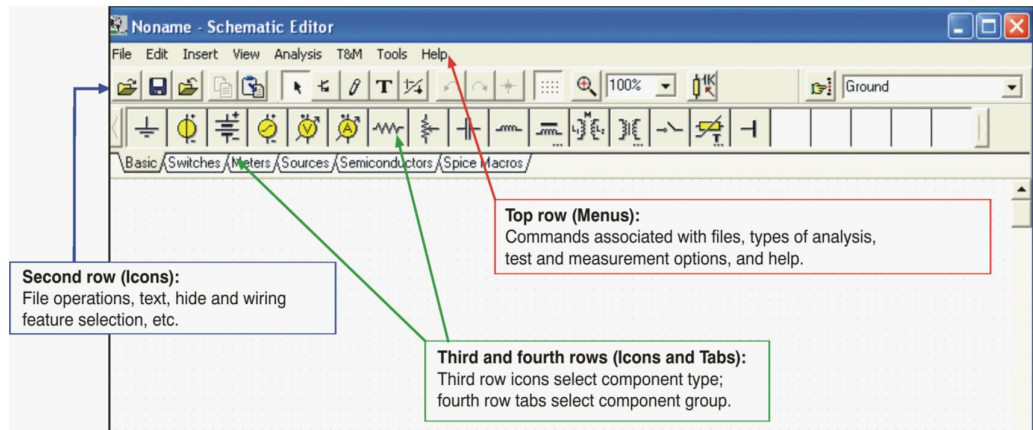


Fig. 1 Schematic Editor Design [2]

Top row of the schematic editor contains the file, edit, type of analysis, test & measurement and help etc. Then the second row of the schematic editor contains the file, hide, wiring feature selection etc. Third and fourth row consist of component type and component group.

A circuit can be built in the schematic window by using all these icons explained above and then components can be connected to each other via wiring Ref. [5]. After the simulation of the circuit we can transfer the same to PCB design. Auto-routing & auto-placement of the components and connection can be directly done using PCB editor and the Gerber file generated of the given circuit Ref. [6]. Finally this Gerber file is used for the PCB manufacturing on Automated Printed Circuit Board Machine.

III. CIRCUIT SIMULATION EXAMPLES

In this section few examples of simulation of the digital circuit has been given using features of TINA software. Example first is about the circuit simulation of OR gate using NAND gate and then further PCB Design of the same has been demonstrated. Second Example is about circuit simulation and then PCB design of the Digital Comparator.

OR Gate using NAND Gates Circuit Simulation:-

The simulated circuit of the OR gate using NAND gates is shown in the Figure 2

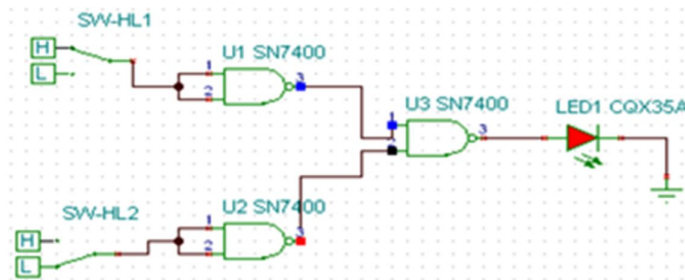


Fig. 2 Schematic of OR Gate using NAND Gates

As shown in the figure components used in the circuit are two switches, three NAND gates, one LED. By using the component group optoelectronics and gates this circuit has been developed. As shown in the figure the LED is on because one of the input is high as it follow the truth table of OR gate. Next step is PCB Design, in this step the schematic of the circuit is opened into the PCB Editor and then with the help of the auto routing and auto placement the design is ready for the PCB Fabrication as shown in the Figure 3.

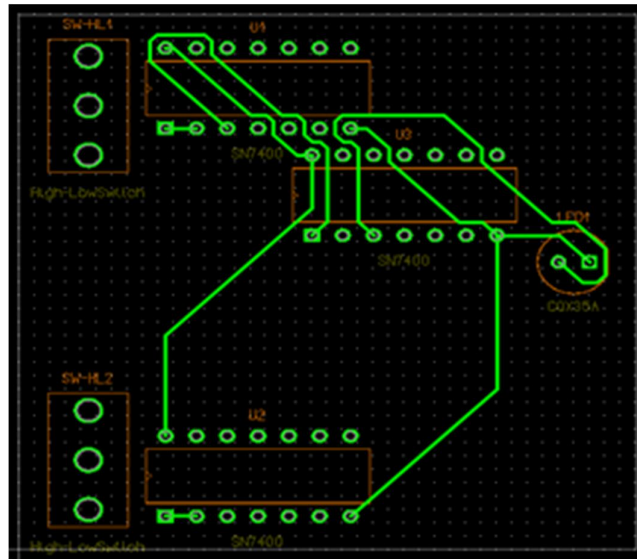


Fig. 3 PCB Layout in PCB Editor

After this PCB layout Gerber file of this model is generated and now PCB layout prepared with the help of the PCB editor is ready for the PCB Fabrication with the help of the Automated Printed Circuit Board machine. Figure 4 and Figure 5 shows the machine used for the PCB fabrication and designed PCB.

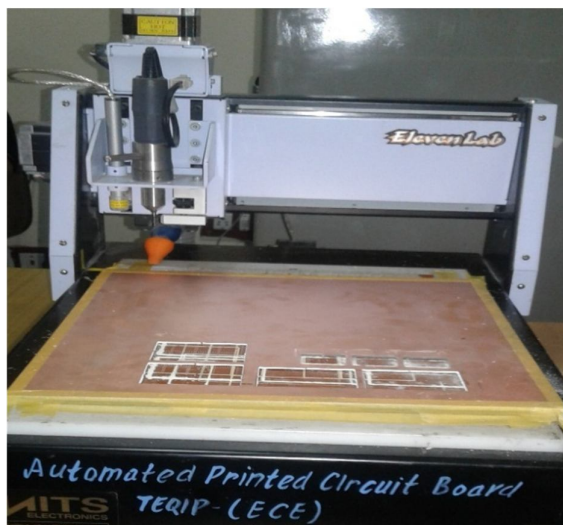


Fig. 4 MITS Eleven APCB Machine [UIET, KUK]

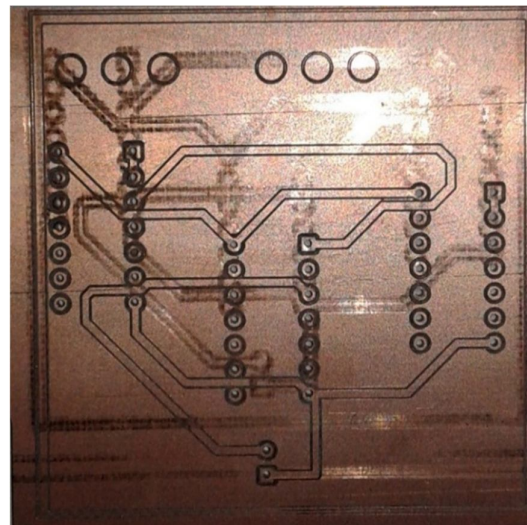


Fig. 5 Fabricated PCB Design

3D model of the same circuit is shown in the Figure 6 which is showing the placement of virtual components on the PCB.

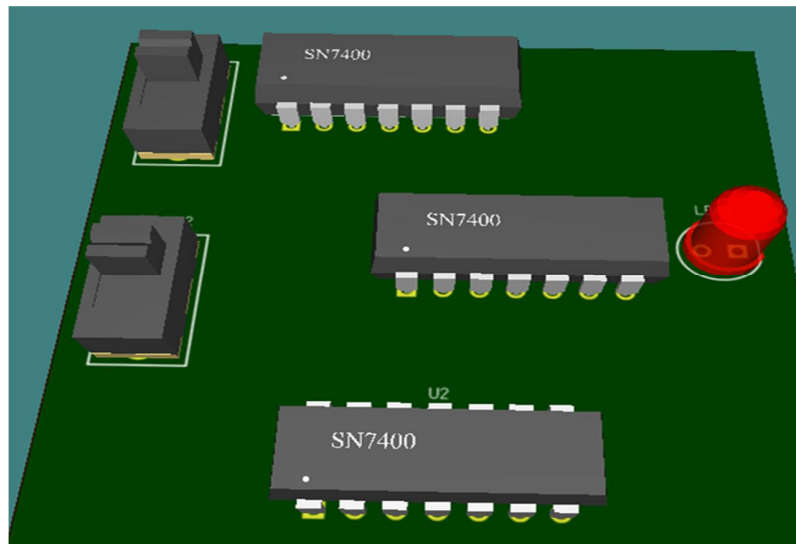


Fig.6 3D Model of OR Gate using NAND Gate

Digital Comparator

The simulated circuit of the digital comparator using digital gates is shown in the Figure 7

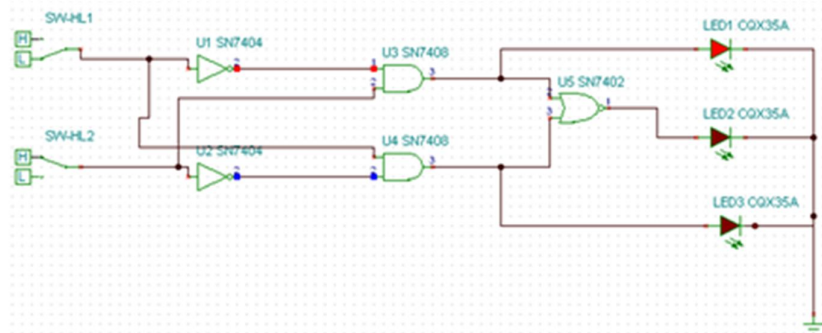


Fig. 7 Circuit of Digital Comparator

As shown in the Figure 7 components used in the circuit are two switches, two NOT gates, two AND gate, one NOR gate and three LED. By using the component group optoelectronics and gates this circuit has been developed. As shown in the figure the first LED is on because switch 1 is at low and switch 2 is at high is high indicating $(1 < 2)$. Next step is PCB Design, in this step the schematic of the circuit is opened into the PCB Editor and then with the help of the auto routing and auto placement the design is ready for the PCB Fabrication as shown in the Figure 8.

IV. CONCLUSION

For the PCB Designing & simulation of the electronics and electrical circuits TINA is a great tool. In this paper digital circuits are simulated with the help of schematic window and PCB layout is prepared using PCB editor, then using this layout required design is fabricated using the Automated Printed Circuit Board machine. In the similar way this tool can be used for the designing & fabrication of the other electrical and electronics circuits. Further in future, value edition can be done by designing & fabricating the RF Devices, Noise Amplifiers, Interdigitated Electrodes, and RFID-Tags etc. using same technique.

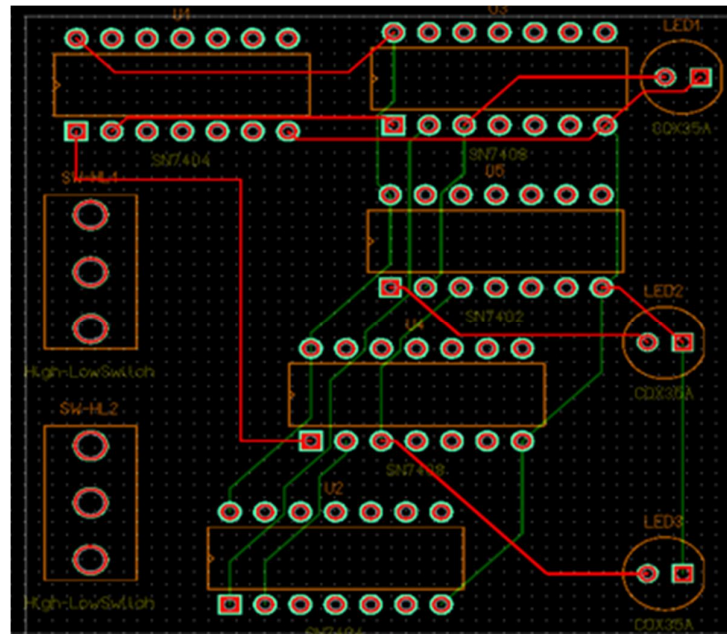


Fig. 8 PCB Layout of Digital Comparator

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